DRISI

Caltrans Division of Research, Innovation and System Information

Research Results

Seismically Testing Backfilled Mechanically Stabilized Earth Walls

MSE retaining walls with recycled tire-derived backfill can sustain strong seismic shaking

Seismic

FEBRUARY 2015

Project Title:
Seismic Responses of Mechanically Stabilized Earth Walls Using Accelerated Alternative Backfill Materials with Recycled Tire Shreds and Lightweight Aggregates

Task Number: 2416

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WHAT WAS THE NEED?

To repair and replace our aging highway and bridge infrastructure with the least impact to the motoring public, accelerated construction techniques are gaining popularity. Mechanically stabilized earth (MSE) walls is one technique that is widely used in retaining embankments in highway systems, because in certain situations they are easier to construct and more economical than conventional reinforced concrete retaining walls. To accelerate construction, alternative materials, such as tire-derived aggregates and lightweight aggregates, are increasingly used as backfill for the retaining walls. Lightweight aggregates consist of clay or shale expanded in a kiln. Tire-derived aggregates are pieces of shredded waste tires, which offer the added benefit of reusing materials that would otherwise be disposed of in landfills or stockpiled. Generally, MSE walls have performed well during past major earthquakes. However, they have not yet been fully tested with the alternative aggregate backfill under seismic conditions.

WHAT WAS OUR GOAL?

The goal was to investigate the seismic performances of mechanically stabilized earth walls with tire-derived or lightweight aggregates as backfill and provide design and construction recommendations for seismic regions.

Tired-derived and lightweight aggregates

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Caltrans provides a safe, sustainable, integrated and efficient transportation system to enhance California's economy and livability.

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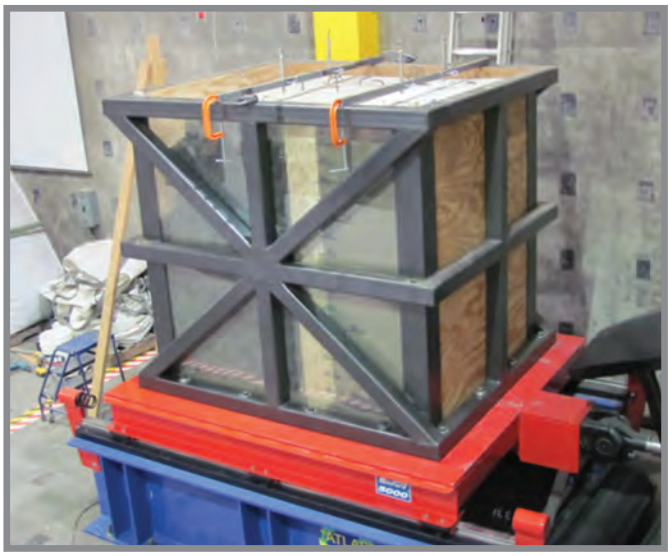
WHAT DID WE DO?

Caltrans, in partnership with the California State University, Fresno Department of Civil and Geomatics Engineering, investigated the seismic performance of MSE walls with tire-derived aggregates and lightweight aggregates as backfill. The researchers tested a 1.5 meters x 1.5 meters x 1.3 meters deep MSE model wall on a one-dimensional shake table. They simulated a full-scale earthquake, comparable to Loma Prieta or Northridge, and sinusoidal sweep-frequency motions (0.2 to 6.0 Hz). A flexible boundary condition was incorporated in the tests, and seismic design was used to construct the internal stability of the MSE wall. The researchers also developed a model using Plaxis geotechnical software to replicate the experimental studies. The numerical model verified the validity of using the spring-supported boundary condition in the shake table testing. The comparison between the numerical and the experimental results warrants further studies to improve the material characteristics and modeling techniques.



Shake table test of an MSE wall

WHAT WAS THE OUTCOME?

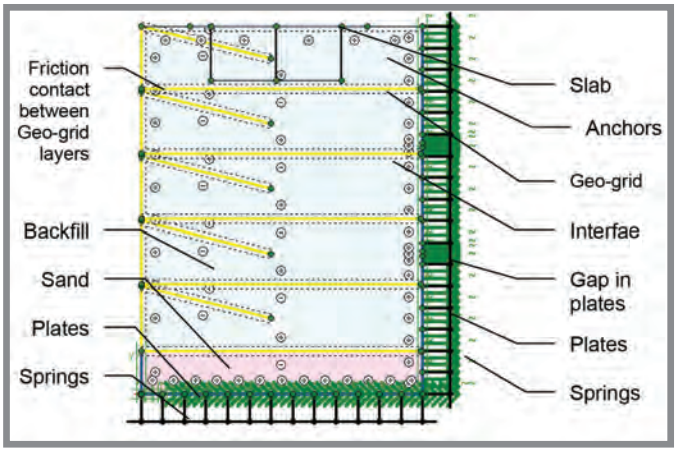
When properly designed, MSE walls with tire-derived backfill can sustain strong seismic shaking without excessive deformation and lateral spreading. Based on the results, tire-derived aggregates perform better in seismic regions than lightweight aggregates. The Federal Highway Administration's seismic design methodology for MSE walls with traditional backfill might be suitable for these alternative backfills.

WHAT IS THE BENEFIT?

Accelerated construction techniques have proven benefits, including minimizing traffic disruption, improved work zone safety, and reduced on-site environmental impacts. MSE retaining walls using recycled tire-derived aggregates as backfill provide an accelerated solution that is environmentally friendly and can reduce costs and save time.

LEARN MORE

To view the complete report:
www.dot.ca.gov/research/researchreports/reports/2013/final_report_65a0449.pdf



Geometry of the MSE model